IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, *et al.*,	)	
	)	
Plaintiffs,	)	
	)	
v.	)	Case No. 4:05-cv-00329-GKF-PJC
	)	
TYSON FOODS, INC., *et al.*,	)	
	)	
Defendants.	)	
	)	

DEFENDANTS' MOTION TO EXCLUDE DR. ROGER OLSEN'S PRINCIPAL COMPONENT ANALYSIS TESTIMONY PURSUANT TO *DAUBERT v. MERRELL PHARMACEUTICALS, INC.* AND INTEGRATED BRIEF IN SUPPORT

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Defendants respectfully move for an order pursuant to Federal Rule of Evidence 702 and *Daubert v. Merrell Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), excluding the testimony of Plaintiffs' expert witness Dr. Roger Olsen as it pertains to a purported "unique chemical signature" for constituents in the environment that he claims to have originated from the land application of poultry litter as a fertilizer. As the Court will recall, Dr. Olsen purports to have employed principal component analysis ("PCA"), a multivariate statistical tool, to identify a unique "poultry signature," that can classify nutrients, metals, bacteria, and other constituents in the environment as having derived from poultry litter. Despite decades of research by others in poultry and environmental sciences, Dr. Olsen is the only person ever to have identified this unique poultry signature in the Illinois River Watershed ("IRW") or any other watershed. His work was undertaken for purposes of litigation and has not been peer reviewed, published, or subjected to any objective, external review outside of Plaintiffs' legal and expert team. Moreover, Dr. Olsen's work is deeply flawed both in concept and in execution. The Court previously found Dr. Olsen's PCA theory to be novel, untested, and unreliable pursuant to *Daubert*, Opinion & Order, Dkt. No. 1765 at 6-7 (Sep. 25, 2008), which decision the Tenth Circuit subsequently affirmed, *Oklahoma v. Tyson Foods, Inc.*, No. 08-5154, Slip. Op. at 21 (May 13, 2009). Nothing has changed to alter that conclusion. Dr. Olsen's work remains untested, unsound, and unreliable, and would be unduly prejudicial if admitted at trial. It is therefore inadmissible pursuant to *Daubert*.

BACKGROUND

Dr. Olsen wears two hats in this litigation. First, he has coordinated Plaintiffs' expert team, working with counsel to shape their scientific case, retain and direct other expert witnesses, implement their sampling program, and manage outside laboratories. Ex. 1,

Preliminary Injunction Transcript ("P.I.T.") at 833:4-8. Second, Dr. Olsen provides Plaintiffs case with causation testimony, attempting to link chemicals, bacteria, and other properties (collectively "constituents") in the environment to poultry litter, through use of his PCA theory. This motion pertains to Dr. Olsen's latter role.

As the Court will recall, PCA is a statistical tool for determining relationships and explaining variances in large data sets. *See* Ex. 1, P.I.T. 805:21-806:1; 859:17-25; Ex. 2 at 6-32; Ex. 3 at 6-15. When applied to any dataset, PCA generates, among other things, numerous "principal components" and "principal component scores" that are driven by and can sometimes help explain variations within the dataset. In this case, Dr. Olsen has attempted to interpret the PCA scores for various environmental samples as being associated with or indicative of particular sources of potential contamination in the IRW. Ex. 1, P.I.T. 817:19-818:7. Based on this analysis, Dr. Olsen derived a PCA score range that, he concluded, indicated impact from poultry litter, and which, he testified, demonstrated poultry litter impact across the IRW. *Id*. at 824:20-828:11.

During the preliminary injunction hearing, Defendants moved to exclude Dr. Olsen's PCA analysis. *See* Response to Plaintiffs' Bench Brief On Oral Motions To Exclude the Testimony of Valerie J. Harwood and Roger Olsen, Dkt. No. 1619 (Mar. 7, 2008). First, we demonstrated that Dr. Olsen's work had been developed solely for this litigation, and was unpublished and untested by anyone not associated with Plaintiffs' counsel. *Id.* at 4-5. Second, we raised substantial questions regarding Dr. Olsen's PCA itself including, *inter alia,* his basis for selecting which data to examine, *id.* at 7-8; his failure to account for alternate sources, *id.* at 8-9; and execution errors in the PCA analysis, *id.* at 9. After reviewing Dr. Olsen's testimony in light of the full record, the Court agreed that his work was novel, unreviewed, and unreliable.

Opinion & Order, Dkt. No. 1765 at 6-7 (Sep. 25, 2008). The Tenth Circuit affirmed, similarly noting Dr. Olsen's subjective role in shaping the data, his failure to perform a fate and transport analysis, and his failure to account for alternate sources of the examined constituents. *Tyson Foods*, Slip. Op. at 21.

Dr. Olsen has now served a report that sets forth substantially the same testimony. He describes the same process, which he applied to water and solids samples collected from the IRW. Ex. 2, Olsen Rpt. at 6-32 – 6-39. He explains his methodology for selecting which data to include in his various PCA runs. *Id*. at 6-39 – 6-46. He used up to 26 target constituents in his water PCA runs, and up to 32 constituents in his solids PCA runs. *Id*. at 6-45 – 6-46. He explains his process for calculating PCA scores, *id.* at 6-49 – 6-54, again relying largely on a "spatial" analyses to assign sources to particular samples and PCA score ranges. *Id.* at 6-54 – 6-62. In his Report, Dr. Olsen concludes that in water a Principal Component 1 score greater than 1.3 equals poultry impact. He further concludes that water with a Principal Component 2 score of greater than 4.7 equals waste water treatment plant effluent ("WWTP"), as well as poultry, impact. *Id.* at 6-59 – 6-61. Based upon these unintelligible and environmentally insignificant "principal component scores," Dr. Olsen concludes that he sees poultry litter impact across the IRW. *Id.* at 6-66.

Dr. Olsen served his initial report on May 14, 2008. On July 25, 2008, he served a 12-page "errata" sheet that made hundreds of edits and revisions to his original report, correcting typographical errors, amending charts, and revising figures. Ex. 4. Defendants took Dr. Olsen's deposition on September 10-11, 2008. Following the deposition, on September 30, 2008, he produced a second "errata" that made extensive and substantive changes to his report, again modifying tables and figures, and also modifying his treatment of a number of samples

questioned during his deposition. Ex. 5.[1] On December 1, 2008, Defendants served the expert reports of Dr. Charles Cowan[2] and Dr. Glenn Johnson.[3] *See* Exs. 3, 7. After reviewing Defendants' reports, on February 10, 2009, Dr. Olsen served a third errata purporting to correct an error pointed out by both Dr. Cowan and Dr. Johnson. Ex. 8. Along with this errata, he again submitted revised text, charts, and figures. *Id*.

DISCUSSION

Federal Rule of Evidence 702 charges a district court to ensure that "scientific testimony … is not only relevant, but reliable." *Daubert v. Merrell Pharm, Inc*., 509 U.S. 579, 589 (1993). In applying *Daubert* the Court should examine a number of factors including:

> (1) whether the opinion has been subjected to testing or is susceptible of such testing; (2) whether the opinion has been subjected to publication and peer review; (3) whether the methodology used has standards controlling its use and known rate of error; (4) whether the theory has been accepted in the scientific community.

Truck Ins. Exch. v. MagneTek, Inc., 360 F.3d 1206, 1210 (10th Cir. 2004). These factors assist

[1] Dr. Olsen's September 30, 2008 errata is clearly untimely pursuant to the Court's scheduling order. *See* Order of January 29, 2009 [Dkt. No. 1839] (reviewing history of the Court's scheduling orders and Plaintiffs' attempts to issue expert "supplements" and "errata" like Dr. Olsen's as late as September 2008). Plaintiffs did not seek leave from the Court to submit what essentially amounts to a new report from Dr. Olsen. The September 30 errata was submitted to bolster Dr. Olsen's opinions in light of observations made by defense experts in their reports and questions posed by defense counsel in his deposition and thus does not qualify as proper expert supplementation pursuant to Rule 26. *See* Order of January 29, 2009 [Dkt. No. 1839] ("A supplemental expert report that states additional opinions or rationales or seeks to 'strengthen' or 'deepen' opinions expressed in the original expert report exceeds the bounds of permissible supplementation and is subject to exclusion.") (internal citations omitted). Defendants therefore request that, if Dr. Olsen's PCA testimony is not precluded under *Daubert*, his untimely errata be stricken.

[2] Dr. Charles Cowan, is a former Chief Statistician for the FDIC, and a former Chief of the Survey Design Branch at the U.S. Census Bureau where he was responsible for evaluating statistical issues associated with the decennial census. Ex. 3 at 1-2.

[3] Dr. Glenn Johnson is a professor at the University of Utah where he focuses on multivariate statistical methods in geology, environmental chemistry, and environmental forensics. Ex. 7 at 2, Apx. B.

the Court in assessing the degree to which an experts' opinion is founded on proper scientific methods. For example, independent review provides "a significant indication that [an expert's work] is taken seriously by other scientists." *Daubert v. Merrell Dow Pharm, Inc.*, 43 F.3d 1311, 1318 (9th Cir. 1995) ("*Daubert II*"); *accord Truck Ins.*, 360 F.3d at 1210; *Bitler v. A.O. Smith Corp.*, 400 F.3d 1227, 1233 (10th Cir. 2004). Similarly, *Daubert* explores both an expert's general methodology, as well as its specific application in the case at bar. As the Tenth Circuit has explained, "'"any step that renders the analysis unreliable renders the expert's testimony inadmissible[,] whether the step completely changes a reliable methodology or merely misapplies that methodology."'" *Tyson Foods*, No. 08-5154, Slip Op. at 17-18 (quoting *Mitchell v. Gencorp Inc.*, 165 F.3d 778, 782 (10th Cir. 1999) (quoting *In re Paoli R.R. Yard PCB Litig.*, 35 F.3d 717, 745 (3d Cir. 1994)).

Applying *Daubert*, the Court previously determined that Dr. Olsen's PCA work and his associated conclusions were unreliable. As demonstrated, *infra*, Dr. Olsen has done nothing to cure this deficit: his methodology remains novel and untested by anyone outside of this litigation; his approach is arbitrary and inconsistent with accepted methods; and his conclusions do not follow logically from the available data. Because Dr. Olsen's PCA work is not grounded in sound science and mathematics, it is unreliable and should be excluded.

A. Dr. Olsen's Novel Methodology Was Devised Solely For Litigation And Has Not Been Reviewed Substantively By Anyone Unconnected To This Lawsuit

The touchstone for *Daubert* reliability is whether the proposed expert testimony has some basis in science external to the lawsuit. "The adjective 'scientific' implies a grounding in the methods and procedures of science." *Daubert*, 509 U.S. at 590. And, as the Tenth Circuit has observed, whether a theory was developed independent of litigation and has been subjected to peer review are "important *Daubert* considerations." *Norris v. Baxter Healthcare Corp.*, 397

F.3d 878, 886 (10th Cir. 2005). Rule 702 prefers theories that have *survived* scientific scrutiny, not those still lying in the cradle. Courts are therefore hesitant to rely on novel scientific theories. Indeed, "without scientific support and research … opinion[s are just] classic *ipse dixit*." *Palmer v. Asarco, Inc.*, 510 F. Supp. 2d 519, 530-31 (N.D. Okla. 2007) (rejecting as novel a theory that lead exposure causes attention deficit disorder); *Ingram v. Solkatronic Chem., Inc.*, 2005 WL 3544244 at **3-9 (N.D. Okla. Dec. 28, 2005) (rejecting expert's "biotransformation" methodology that, while derived from existing methodologies, and despite the possibility that it might one day be an accepted theory, was unsupported in pre-existing literature); *B.H. ex rel. Holder v. Gold Fields Mining Corp.*, 2007 WL 188130, at *6 (N.D. Okla. Jan. 22, 2007) (excluding opinion unsupported by testing, data, or other scientific principles).

While external corroboration does not guarantee validity, it will "increase the likelihood that substantive flaws in methodology will be detected." *Daubert*, 509 U.S. at 593. "Proposed testimony must be supported by appropriate validation" external to the proponent's own work. *Id.* at 590. Conversely, scientific theories generated solely for the purpose of litigation are suspect: "[A] scientist's normal workplace is the lab or the field, not the courtroom or the lawyer's office." *Daubert II*, 43 F.3d at 1317-18. Indeed, hired expert testimony can "turn[] scientific analysis on its head[,] … reason[ing] from an end result in order to hypothesize what needed to be known but what was not." *Mitchell*, 165 F.3d at 783 (quotations omitted); *see also Cabrera v. Cordis Corp.*, 134 F.3d 1418, 1420-21 (9th Cir. 1998); *Sorenson v. Shaklee Corp.*, 31 F.3d 638, 649 (8th Cir. 1994). Ultimately, "the examination of a scientific study by a cadre of lawyers is not the same as its examination by others trained in the field of science or medicine." *Perry v. United States*, 755 F.2d 888, 892 (11th Cir. 1985); *see Allgood v. GM Corp.*, 2006 WL 2669337, at **17-18 (S.D. Ind. Sept. 18, 2006) (rejecting as novel a source tracking

methodology that employed a "ratio analysis" to establish a causal pathway).

Dr. Olsen's claimed "poultry signature" is completely novel. In all the years and in all the research by industry, academic, and government scientists into the poultry sciences, Dr. Olsen alone has divined that the presence of these 25 to 32 constituents (depending on the run and depending on the media) in certain combinations or proportions proves the presence of poultry litter impact. Ex. 1, P.I.T. 865:8-866:2.[4] As Dr. Olsen candidly admitted, "no other people outside the group or our scientific reviewer has seen this, so no one else has made that conclusion." *Id.* at 864:21-23. Instead, it was his "unique work to develop that signature." *Id.* at 866:9. Not only has no one conceived of this "signature" previously, but no one outside of this litigation has reviewed it subsequently. Dr. Olsen testified that he intended to submit his work for peer review and publication, *Id.* at 864:5-13, but he has not done so. Dr. Olsen's PCA analysis has never been published or otherwise independently examined. *See Tyson Foods*, No. 08-5154, Slip. Op. at 21.

Far from deriving from independent science, Dr. Olsen developed his "poultry signature" solely for use in this case. Dr. Olsen was paid for that effort. As of September 2008, his firm, Camp, Dresser McKee ("CDM") had been paid well in excess of $8 million for its work on this case, money that came not from the State of Oklahoma but from Plaintiffs' private counsel. Ex. 9 at 7:4-12; *see also* Ex. 1, P.I.T. at 832:7-22. The samples underlying Dr. Olsen's PCA

[4] Dr. Olsen's experience and credentials do not lend additional support to the validity of his PCA work. Rule 702 invites the submission of testimony by experts who by virtue of their "knowledge, skill, experience, training, or education" bring some particular expertise to bear that "will assist the trier of fact to understand the evidence or to determine a fact in issue." Fed. R. Evid. 702. But Dr. Olson is not a statistician or mathematician by training or education. Ex. 1, P.I.T. 773:18-24. Nor has he been employed as a statistician or mathematician. *Id.* at 774:5-14. Nor has Dr. Olsen ever published any peer reviewed publication describing the results of a PCA analysis used to identify the source of alleged contaminants. Ex. 9 at 306:2-8. Nor has he ever been qualified as an expert on using PCA to identify contamination sources. *Id.* at 305:7-12.

analyses were gathered by Plaintiffs' field crews primarily during 2006 and 2007, and his PCA work followed. *See* Ex. 2 Apx. F (listing collection dates as part of sample IDs). Yet, well before any of that was done, Plaintiffs' counsel instructed Dr. Olsen "principle component analysis by CDM to show bacteria is associated with land applied poultry waste." Ex. 10 (Memorandum from Counsel (Sept. 14, 2005)) at 3; *see id.* (instructing to "[u]se current/existing CDM data and lake sediment analysis along with principal component analysis to show that bacteria originated from land applied poultry waste); *id.* at 5 (also instructing to "[u]se all data collected by CDM and using principal component analysis to establish that Phosphorous in chicken waste is found in Lake Tenkiller."). This work resulted not from the scientific method but from the litigation method.

During the course of his investigation, Dr. Olsen ran his PCA analysis "hundreds" of times using myriad combinations of contaminants and sample results. *See* Ex. 1, P.I.T. 890:10-14; Ex. 2 at 6-50 (confirming that "[m]any different PCA runs were conducted"); Ex. 7 at 3; Ex. 9 at 462:2-10. Over the past year and a half, he has offered shifting explanations to support his conclusions. *See* Ex. 7 at 40-50 (documenting the evolution of Dr. Olsen's explanation for why there is no cattle signature). And, he has repeatedly had to revise his analysis to remove or work around flawed data, or his own miscalculations. But one thing has been consistent from the start: throughout all his PCA runs, across all his testimony, in all of his errata, with good data or bad, and no matter what the samples or constituents, Dr. Olsen always sees a poultry litter "signature" that no other scientist has ever seen.

At bottom, Dr. Olsen's PCA methodology is novel, was created solely for use in this litigation, and has never been reviewed by anyone unconnected to this litigation. It is therefore unreliable and inappropriate for admission under *Daubert*.

B. Dr. Olsen's PCA Methodology Is Arbitrary, Speculative, Internally Inconsistent, And Unsupported By The Available Data

In considering a *Daubert* challenge, a district court should both examine the expert's theory and assess the reliability of the expert's application of a particular methodology to the data and facts of the particular case. *Tyson Foods*, No. 08-5154, Slip. Op. at 16-19. An "expert['s] conclusions are not immune from scrutiny: 'A court may conclude that there is simply too great an analytical gap between the data and the opinion proffered.'" *Hollander v. Sandoz Pharm. Corp.*, 289 F.3d 1193, 1205 (10th Cir. 2002) (quoting *General Elec. Co. v. Joiner*, 522 U.S. 136, 147 (1997)). Specifically, the district court "'must assess the reasoning and methodology underlying the expert's opinion, then determine whether it is scientifically valid and applicable to a particular set of facts.'" *United States v. Benally*, 541 F.3d 990, 994 (10th Cir. 2008) (quoting *Burlington N. and Santa Fe Ry. Co. v. Grant*, 505 F.3d 1013,1030 (10th Cir. 2007)); *see also Norris*, 397 F.3d at 885-86 (same); *Dodge v. Cotter*, 328 F.3d 1212, 1221-22 (10th Cir 2003) (same). Here, both Dr. Olsen's methodology and application are deeply flawed and unreliable.

1. Dr. Olsen's Results Are Arbitrarily And Selectively Chosen For Presentation

Dr. Olsen ran his PCA analysis hundreds of times, using many different permutations of samples and test results. Ex. 1, P.I.T. 890:10-14. His work papers for developing his report identify 22 separate PCA runs on water samples, and 7 runs on solids samples. Ex. 7 at 11. Of these, Olsen declares just four to have been the "the most important to the investigation or project objectives:" "SW3" and "SW17" for water, and "SD1" and "SD6" for solids. Ex. 2 at 6-50; Ex. 7 at 11. Yet, nowhere does Dr. Olsen explain why, of all the runs, these four are the "most important" or how they relate to "the investigation or project objectives" in a way that others do not. Moreover, having declared SD6 to be "important," Dr. Olsen then gives it but a

single, conclusory paragraph in his report. Ex. 2 at 6-62; Ex. 7 at 33. He then relies on a totally different run, SW22, which was not listed among "most important," for his conclusion that there is no cattle signature in the IRW. Ex. 7 at 11.

While Dr. Olsen does not explain the need for these many runs or why some are the most important, his work papers do. As Dr. Johnson recounts, and as is discussed *infra*, Dr. Olsen's repeated surface water runs were conducted in an effort to find a combination of data that would support his assertion at the preliminary injunction hearing that cattle in the IRW display a consistent, recognizable signature, but to no avail. Ex. 7 at. 47-50. With no other coherent explanation as to why these runs were necessary, or why the four named runs are the most representative or accurate, these selections appear to be at best simply arbitrary.

The arbitrariness and selectivity of Dr. Olsen's presentation of data is underscored by his treatment of his first "important" PCA run on solids, SD1. Dr. Olsen relied on SD1 to support the proposition that cattle manure generates a different PC result than poultry litter. Ex. 2 at 6-56. And indeed, as Dr. Olsen's Figure 6.11-20c shows, the two plot differently. *See* Ex. 2. The chart also shows, however, that the cattle samples plot much closer to the surface soil and sediment samples than they do to poultry litter, which plots increasingly far away from the soil/sediment samples. According to Dr. Olsen, the closer two scores plot, the more similar their chemical makeup. What this chart actually suggests, then, is that the supposedly "contaminated" soil and sediment samples collected by CDM more closely resemble the chemical makeup of cattle manure than poultry litter. Ex. 7 at 31.

Rather than acknowledge this, Dr. Olsen introduces for the only time in his report a third

principal component, PC3,[5] which is charted against PC2 on Figure 6.11-20e. Exs. 2, 6. Based on this, Dr. Olsen asserts that poultry litter plots directly on top of the soil/sediment samples. Ex. 2 at 6-62. But this is nothing more than an optical illusion. As Dr. Johnson explains, each principal component is drawn at a right angle to the one preceding it. All Dr. Olsen has done is to look at Figure 6.11-20c from a different angle (from the perspective of the blue-shaded eye on Dr. Johnson's Figure 2-13 in Ex. 7), thus hiding the separation between litter and soil/sediment samples along the *x* axis. *See* Ex. 7 at 31-32. Dr. Olsen's analysis is akin to viewing an eclipse and concluding that because they overlap, the sun and the moon must be close together. This presentation is selective and arbitrary at best, and intentionally misleading at worst.

2. Dr. Olsen's Alleged "Poultry Signature" Represents His Own Subjective Selections, Not The Product Of A Principal Component Analysis

Dr. Olsen admits that the statistical software package that he used to run his PCA analysis does not determine the relative contributions of constituents from different sources in the IRW. Ex. 1, P.I.T. 839:4-9. In fact, PCA does not even identify the source of any particular component or any particular sample. *Id.* at 861:23-862:5. And, PCA analysis certainly does not connect any particular constituent in the environment with any particular farm or Defendant. *Id.* at 897:21-898:4. Instead, the determination that particular samples reflect particular sources of constituents is the subjective determination of the person interpreting the results of the PCA, in this instance, Dr. Olsen. *Id.* at 863:5-864:4. The red ovals on Dr. Olsen's Figure 6.11-18c, claiming to show "WWTP Dominant Impact" and "Poultry Waste Dominant Impact", *see* Ex. 6 at Figure 6.11-18c; Ex. 8, at Corrected Figure 6.11-18c, are his own creation.

Dr. Olsen's PCA assigns each sample a numerical score that represents its relationship to

[5] Dr. Johnson discusses the significance of Dr. Olsen's failure to include additional principal components in his analysis, and the likelihood that these later runs, that by Dr. Olsen's own analysis describe nearly 50 percent of the variability in the data, are actually much more likely to be useful in ascertaining the cause of the variability.

the overall variability in the set. To determine which samples (and which corresponding PCA range) equal "poultry impact," he relied principally on a separate "spatial" analysis, comparing samples and scores with information known about each sample or collection point. Ex. 9 at 284:23-285:15. Based on this undocumented, poorly described and clearly subjective "analysis," Dr. Olsen concluded in his initial report that any score between 1.3 and 4.7 indicated a "unique poultry signature." Ex. 2 at 6-59 – 6-61; Ex. 7 at 13-14. These results are presented on Figure 6.11-23, which purports to show the locations of poultry-impacted samples throughout the IRW.[6] *See* Ex. 6.

But Dr. Olsen's "spatial analysis" was itself arbitrary. He purports to have compared PCA results with known information about various samples to calibrate his source attributions. Ex. 2 at 6-59–6-60. However, Dr. Olsen actually examined only a handful of samples, for example only 27 of the 572 samples from 5 of 175 sample locations in SW3. Ex. 7 at 15. His handpicked examples ignored the many samples that contradict his conclusions. *Id.* For example, when all of Dr. Olsen's high flow samples are plotted over poultry house density data generated by Plaintiffs, many allegedly poultry-impacted samples (*i.e.* PC1 score >1.3) fall where by Dr. Olsen's analysis there should be none. *See* Ex. 7 at 15-18, 20-24; 51-54. Dr. Olsen's base flow samples demonstrate a similar disjunction. And in fact, these scores track better with urban density than poultry density. *Id.* at 54-56.[7]

Indeed, Dr. Olsen's misplaced "poultry signature" samples originally included five samples taken within the town of Tahlequah, a human-impacted, not poultry impacted, area. Dr.

[6] As Dr. Johnson notes, this chart presents the samples that Dr. Olsen's own analysis determined were "WWTP Dominant" samples as being "poultry impacted." Johnson Rpt. at 15.

[7] For example, the PCA showed poultry litter impact in Tahlequah, an area Dr. Olsen concedes has zero poultry houses. Olsen 9/11/08 Dep. at 414:4-9. Instead of re-evaluating the validity of his principle component analysis, he simply "reclassified them" to non-impacted. *Id.* at 414:12-14.

Olsen's results showed that these five urban samples each had a PC1 score in excess of 1.3 and thus demonstrated the presence of poultry based on Dr. Olsen's standards. Ex. 7 at 34. Dr. Olsen's report concealed this by presenting these samples as being not poultry impacted without any explanation of his subjective decision to deviate from the PC1>1.3 cutoff he established. *See* Ex. 6, Fig. 6.11-23; Ex. 7 at 34. When challenged at his deposition, Dr. Olsen admitted that his 1.3 cutoff was subjective, and that despite having represented that his "spatial analysis" confirmed the validity of the cutoff, explained now that he had used that same analysis in the context of these urban samples to ignore it. *See* Ex. 7 at 34-35; Ex. 9 at 405-409; *see also* Ex. 9 at 273:18-278:21 (agreeing that his 1.3 cutoff is less than precise and that "t[h]ere may be a few minor exceptions").

Dr. Olsen experienced similar inaccuracies with his WWTP samples, all of which had PC1 scores greater than 1.3 and therefore reflected, according to Dr. Olsen, the poultry signature. In fact, the sample from the Lincoln WWTP plotted within the area Dr. Olsen identified as reflecting only poultry impact. Ex. 7 at 37. When challenged at his deposition, Dr. Olsen agreed that these samples from human wastewater systems should not have been counted as poultry-impacted areas, and subsequently removed them from his analysis. Ex. 9 at 274:15-275:6; 330:3-7. But, in doing so he failed to explain the contradiction that these scores posed to his essential claim that a PC1 score above 1.3 represents a "unique poultry signature." Ex. 7 at 37-39.

Aside from the fact that Dr. Olsen's "unique poultry signature" tested positive in urban areas and human wastewater systems, Dr. Olsen's spatial analysis is also undone by his repeated efforts to discount the existence of a cattle signature. First, at the preliminary injunction hearing, Dr. Olsen assured the Court that "cattle waste" had a distinct signature that he could recognize.

"I went to specific samples that I knew had cattle waste in it and I could see a distinct difference, particularly with the poultry waste. So I knew what I was looking for and it just wasn't a dominant signature across the basin…. If it had been, I would have found it." Ex. 1, P.I.T. 844:21-845:5. Dr. Olsen's subsequent report, however, says nothing about this "distinct" cattle signature. Quite the contrary, it argues, based on the SW22 run, that cattle manure plots across a wide and dispersed area and has no distinct signature. Ex. 2 at 6-62; Ex. 7 at 42.[8] Interestingly, all four of the allegedly cattle-impacted samples that Dr. Olsen discusses had PC1 scores higher than 1.3, making them, by Olsen's analysis, poultry impacted.[9] When challenged with this fact at his deposition, Dr. Olsen changed his analysis again, this time suggesting that perhaps the samples were not actually cattle-impacted at all. Ex. 9 at 282:15-24, 369, 388:1-17. This, however, is contradicted by the very field notes that had supported his initial reliance on these samples as cattle impacted, which state that the field in question had "never been applied with poultry waste." *See* Ex. 7 at 45.

As the foregoing demonstrates, the analysis upon which Dr. Olsen relied to confirm the validity of his 1.3 cutoff was subjective, arbitrary, and inconsistently applied, and in many instances contradicts his claim that any score above 1.3 (or 2.0 or 2.60, *see infra*) indicates a unique poultry signature.[10]

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[8] As Dr. Johnson notes, this description better describes Dr. Olsen's edge-of-field poultry samples than his cattle samples, yet Dr. Olsen concludes that these evince a "signature" whereas based on the same logic cattle do not. Ex. 7 at 43-44.

[9] In fact, Dr. Olsen concealed the existence of a fifth cattle impacted sample by treating two samples as one by averaging them. *See* Ex. 7 at 42. Had he not done so, then all *5* cattle-impacted samples would have, according to his "unique" signature analysis, been poultry litter.

[10] As Dr. Johnson recounts, Dr. Olsen's shifting methodologies were purposeful, as his e-mail records demonstrate a concerted effort to develop PCA runs that supported his preliminary injunction testimony. It was this effort that resulted in the running of so many different surface water runs. Ex. 7 at 47-50. Only after he failed to do so did he adopt his "broad spacing equals no signature at all" rationale. *Id.*

3. Dr. Olsen's Log Conversion Error and Third Errata

Finally, the inherent subjectivity and unreliability of Dr. Olsen's analysis is best underscored by the subject matter of his third errata. Dr. Olsen had to produce this errata after Dr. Cowan and Dr. Johnson demonstrated that Dr. Olsen had committed a math error that invalidated his entire analysis. Specifically, having calculated his PC scores using the logarithmic value of his data, he then improperly applied those scores to his original, raw data rather than their logged values. *See* Ex. 7 at 11-12, 26, 30, 33, A17-19; Ex. 3 28-33. Dr. Olsen acknowledged the mistake and purported to correct the error, which he tries to pass off as a mere "programming error" that "had no impact on the PCA results." Ex. 8 at 3. This is demonstrably false.

First, interestingly, despite acknowledging the mistake and recognizing the consequent need to recalculate his PCA scores and re-conduct his analysis, Dr. Olsen's errata does so only for two of the four PCA runs that he declares "most important" and that underlie his analysis. While the errata addresses SW3 and SW17, *see* Ex. 8 Attch. B (corrected text), it says nothing regarding SD1, SD6, or SW22, *see* Ex. 12 (Johnson Decl.) at 2. Therefore, by Dr. Olsen's own admission, any conclusions drawn from those runs must now be discarded.

Second, it is simply not the case that Dr. Olsen's Third Errata merely fixed a "programming error" that had no effect on his analysis. Quite the contrary, it completely altered his claimed cutoff for his "poultry signature" and resulted in the reclassification of numerous of his data points. Whereas the cutoff previously was 1.3 for both SW3 and SW17, the Third Errata adjusted it to 2.0 for surface water and 2.6 for groundwater. *See* Ex. 8 at 6-59 – 6-61; Ex. 12 at 4, 7. Moreover, it changed the classification of a substantial number of samples. In the revised SW3, 23 samples that Dr. Olsen previously swore were not poultry-impacted are now classified

as poultry impacted; and 41 samples he previously swore were poultry-impacted are now given a clean bill of health. Ex. 12 at 5. Similarly in the revised SW17, 95 samples change classification: 54 are newly poultry-litter impacted; and 41 are newly not. *Id.* at 8. Nor do these moving points cluster around the shifted cutoff line. As Dr. Johnson demonstrates, for both SW3 and SW17 the moving points exhibit a wide range of scores. *Id.* at 6, 9. Nor are these moving samples geographically concentrated. Rather, they range the width and breadth of the watershed. *Id.* at 7, 9. Interestingly, where Dr. Olsen previously testified that each and every water sample from Lake Tenkiller displayed poultry impact, he now allows that nine samples from three locations are not poultry litter impacted. *Id.* at 7.

Dr. Olsen's Third Errata did nothing to fix any of the other errors pointed out by Drs. Cowan and Johnson, nor for that matter did it fully fix the log conversion error for all of Dr. Olsen's report. What it did do, however, was highlight the inherent subjectivity of Dr. Olsen's analysis, and the degree to which the classification of points as poultry-impacted or not depends not on sound math and science but rather upon his own arbitrary classification.

C. Dr. Olsen's PCA Analysis Is Not Corroborated By A Fate and Transport Analysis And Therefore Cannot Account For Alternate Sources Of The Constituent Parts Of Dr. Olsen's "Poultry Signature"

Plaintiffs' essential allegation is that constituents from poultry litter travel substantial distances from field surfaces to recreational and ground waters in the IRW. In order to demonstrate causation—that poultry litter is the source of the objected-to constituents—Plaintiffs must tie constituents found in recreational and ground waters back to litter-amended fields. Dr. Olsen's PCA purports to do so by positing that certain constituents when found in particular locations in particular combinations or proportions and with particular characteristics constitute a "poultry signature," thus indicating the source of those constituents. But Plaintiffs' failure to perform any fate and transport analysis and failure to account for alternate sources of the

constituents in his "signature" irretrievably confound any such claim.

A detailed fate-and-transport study is ordinarily necessary to follow specific chemicals, metals, bacteria, or other target of interest through the environment. *See Hatco Corp. v. W.R. Grace & Co.-Conn.*, 836 F. Supp. 1049, 1060-63 (D.N.J. 1993) (discussing elements of fate and transport analysis). A proper study (if even possible in a million-acre watershed) would take into account the varied fate and transport characteristics of and differing correlations between different constituents, including the many factors that slow or degrade alleged contaminants including temperature, sorption, filtering, humidity, pH, topography, chemical and physical reactions, and vegetation. *See id.* at 1060-61; *Kalamazoo River Study Group v. Eaton Corp.*, 258 F. Supp. 2d 736, 756-57 (W.D. Mich. 2002) (discussing need to consider alternate sources in fate and transport analysis); *see also Allgood*, 2006 WL 2669337, at **17-18 (rejecting novel "ratio analysis"); *City of Wichita v. Trustees of APCO Oil Corp. Liquidating Trust*, 306 F. Supp. 2d 1040, 1108-11 (D. Kan. 2003) (rejecting groundwater modeling developed in part by Dr. Olsen as unreliable in part because it failed to account for typical fate and transport considerations, instead proposing a novel and untested methodology devised for litigation).[11]

Such a study is important for effective source tracking. As Dr. Harwood testified, in order to be an effective source indicator, a constituent "would have to have certain fate and transport characteristics in common" with whatever it is supposed to be indicating. Ex. 11, at 151:21-152:5. And, as Dr. Teaf testified, in a system with multiple sources of the target constituent, some "contribution analysis" is necessary to sort between alternate sources. Ex. 1, P.I.T. 239:22-240:6; *see also id.* at 843:3-11 (Dr. Olsen agreeing that different constituents move at different rates). Yet here, Plaintiffs have undertaken no such analysis. *See, e.g.*, *id.* at 680:16-

[11] *See also Renaud v. Martin Marietta Corp.*, Inc., 972 F.2d 304, 307-08 (10th Cir. 1992) (fate and transport of chemical over an 11-year period not demonstrable from a single data point).

18, 688:24-699:17 (Dr. Harwood did not conduct a fate and transport analysis); *id.* 301:21-302:10 (Dr. Teaf did not conduct a formal fate and transport analysis); *id.* 405:8-13 (Dr. Fisher did not conduct a fate and transport analysis of bacteria); Ex. 9 at 25:21-26; 318:21-319:6 (Dr. Olsen not asked to track movement of litter constituents from particular land-application sites to allegedly contaminated waters or sediments); Ex. 11, at 9:9-13; Ex. 13, at 84:22-25, 86:21-87:2. The Tenth Circuit found this failure to be significant. *Tyson Foods,* No. 08-5154, Slip Op. at 14. And now, not only have Plaintiffs not performed such an analysis, but Dr. Olsen now disclaims any need to account for fate and transport factors at all. Ex. 9 at 565:17-566:6.

Instead, Plaintiffs propose Dr. Olsen's testimony as a shortcut to tie constituents found in environmental samples back to poultry litter-amended fields without any analysis of the myriad intervening fate and transport factors. But this approach assumes that the constituents included in his PCA—the "signature"—move through the environment at the same rate and persist consistently in the same proportions to each other. But Plaintiffs have adduced no evidence to support such an assumption. Nor can they, for any such assumption is confounded by the fact that most, if not all, of the components of his PCA analysis have one or many sources within the watershed apart from poultry. Ex. 1, P.I.T. 868:1-872:8. Indeed, many of them occur naturally in the IRW. *See, e.g., id.* at 870:4-14, (limestone and calcium); 871:25-872:5 (nitrogen); 872:5-8 (potassium). Nor does Dr. Olsen's methodology account for alternate sources of bacteria. *Id*. at 881:7-882-17. Dr. Olsen has provided no reason for this Court to assume not only that the constituent elements of his PCA travel together in the same, fixed ratios, but in fact dissipate at precisely the same rate at which they are injected by alternate sources.

In fact, any such assumption breaks down at the first. Ex. 14 at 2-4 – 2-9. As Dr. John Connolly demonstrates, the chemical makeup of Plaintiffs' surface water samples differs

substantially from the makeup of purportedly poultry-impacted edge-of-field samples. *See id.* at 2-4 – 2-9 and Figures 2-3, 2-4a&b. The fact is that, because PCA cannot account for the natural and chemical processes that occur during transport and the presence of intervening alternate sources, it is an inappropriate tool to use in measuring a system where components have multiple sources. Ex. 1, P.I.T. 884:15-885:12. Dr. Olsen's effort to force his "signature" analysis bluntly into PCA should be rejected.

D. Dr. Olsen's PCA "Poultry Signature" Work Is Based On Inconsistent, Flawed, Corrupted, And Unreliable Data

In order for an expert's analysis and conclusions to be admissible, they must be based on reliable data. *See* Fed. R. Evid. 702 (expert opinion must be based on "sufficient facts or data"); *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 149 (1999) (trial court must assess reliability of experts' data). This feeds directly into the principal *Daubert* inquiries of whether an experts' work can be tested and reproduced, is governed by known standards, and has a measurable error rate. *Truck Ins. Exch. v. MagneTek, Inc.*, 360 F.3d at 1210. Defendants previously challenged Dr. Olsen's data selection. *See* Dkt. No. 1619, at 7-9; *Tyson Foods*, No. 08-5154 at 21. Indeed, the Court will recall that only days before the preliminary injunction hearing, Dr. Olsen discovered that his PCA had included data that his fellow experts had rejected as unreliable. Ex. 1, P.I.T. 828:12-830:21. Dr. Olsen agrees that data must be gathered according to consistent methods. *Id.* at 886:21-887:14. But detailed analysis now confirms that Dr. Olsen's opinions are still based on a deeply flawed and inappropriately compiled dataset, which substantially hinders other experts from reproducing his work and testing his conclusions, and which introduces substantial but unquantifiable error rates. *Truck Ins.*, 360 F.3d at 1210; Ex. 3 at 36-51; Ex. 7 at 9, A-13 – A-14. Accordingly, conclusions based on that dataset are suspect and should be rejected.

As Dr. Olsen agrees, a PCA is only as good as the data fed into it, and the throughput of the analysis depends entirely on the reliability of the data selected by the operator. Ex. 1, P.I.T. 840:15-19. Here, Dr. Olsen began with Plaintiffs' master Microsoft Access database containing the results of all the tests on all of Plaintiffs' samples. Ex. 2 at 6-35; Ex. 7 at 3. The Access database was then mined for data for water and solid samples, which were gathered in Microsoft Excel spreadsheets. *Id.* During the four years in which they prepared their case, Plaintiffs gathered thousands of samples, and tested them for more than 100 different constituents. Ex. 1, P.I.T. 840:20-841:3; Ex. 2 at 6-39; Ex. 7 at 9. Plaintiffs, however, did not test each sample for each constituent; in fact, they did not even run the same battery of tests on all like samples (*i.e.*, water). Ex. 2 at 6-35 – 6-38; Ex. 3 at 16. Consequently, there are "holes" in the dataset that Olsen started when it comes the presence, absence or concentration of many of the 26 to 32 constituents used in his PCA runs. In addition, some samples have no data for some constituents because the tests that were run came back as "non-detects," *i.e.* if the constituent was present, it was "below the detection limit." Finally, some samples were tested multiple times for the same constituent, resulting in multiple values for that constituent (such as water samples tested repeatedly for bacteria). Ex. 3 at 16. As a result, Plaintiffs' data is a patchwork quilt of different results for different constituents for different samples.

Dr. Olsen did not include each and every water or solid sample in his PCA runs, but rather hand-selected a subset of samples and constituents. Ex. 2 at 6-42 – 6-46. He excluded samples that were missing too much data or had too many non-detects, but did include in his runs many samples that were missing some data. *Id.* at 6-43 to 6-44; Ex. 9 at 416:16-417:23. For example, his SW3 run, upon which he relies for his "poultry signature" claim, Ex. 7 at 11, included a total of 573 samples of which only 267 had real-world data for each of the 26

included constituents; the remaining 306 samples—53 percent of the total—were each missing some data for some of those constituents. Ex. 3 at 19; Ex. 7 at 9, 11.[12] This substantial amount of missing data results in several biases.

1. Substitute and Hypothetical Data

In order to have a full set upon which to run his PCA, Dr. Olsen had to complete his dataset. To do so, for each missing datapoint Dr. Olsen simply substituted in the mean of all of the other values for that constituent in the dataset. Ex. 9 at 420:2-22.[13] The creation of this hypothetical data has two distorting effects. First, by creating data for constituents allegedly associated with poultry litter where none was measured, Dr. Olsen biases his dataset in favor of his own initial hypothesis, that the presence of these elements proves the presence of poultry litter. Ex. 3 at 19. Second, the substitution alters the variability in the overall dataset, the very thing that a PCA is used to explain. Each principal component (PC1, PC2, etc.) compares variables on two axes, with *x* values and corresponding *y* values. The object is to determine whether these share some relationship that explains their variability. By substituting missing *x* and *y* values with the average of all other *x*'s and *y*'s without reference to each missing value's corresponding *x* or *y* value, the substitution distorts whatever correlation there is to measure. This substitution actually *increases* the overall potential variability in the dataset, and distorts the resulting principal component. Ex. 3 at 22-25.

Given these distorting effects Dr. Olsen should have performed some analysis to

[12] Dr. Johnson sets out the missing data for each of Dr. Olsen's "important" runs, *see* discussion *infra*, including specifically identifying those constituents in each run that were missing more that 10 percent of their data. *See* Ex. 7 at 12, 19, 26, 30, 33.

[13] Plaintiffs' Counsel represented during Dr. Cowan's deposition that Dr. Olsen in fact employed a function in his PCA program, *Systat*, called "pairwise deletion," which performs a calculation to substitute in for missing data which is the mathematical equivalent of substituting in the mean. Ex. 15 at 280:6 – 284:2.

determine the significance of the missing values. He did not. Had he done so, he would have learned that the missing data substantially biases the PCA scores he computed. A comparison of the data for the samples with complete data sets with the data for the samples that were missing some data demonstrates that the missing data was not missing at random. In fact, as Dr. Cowan demonstrates, only 8 of the 26 constituents included in SW3 had means in each half that were comparable. Ex. 3 at 20-21. The balance displayed significant variation. *Id.* This does not explain *why* the missing data is not random, but it does demonstrate that replacing missing data with the mean of the measured data biases the outcome. *Id.* at 22.

2. Averaging Multiple Values For The Same Sample

A second problem is caused by Dr. Olsen's treatment of samples that have multiple readings for the same constituent, such as water samples that were tested multiple times for fecal coliforms. *Id.* at 16. Rather than include all of this data, Dr. Olsen includes only the average of all the measurements. *Id.* PCA is designed to explain variability in a dataset. By averaging out multiple readings, Dr. Olsen artificially reduced the actual variability, which results in a relationship between the averaged constituents and the other constituents being misstated. *Id.* at 17. Specifically, here, it overstates the effect of phosphorous and understates the effect of the averaged variables. *Id.*

3. Substitution of Inconsistent Values for Non-Detects

A third data problem is the manner in which Dr. Olsen treats non-detects. Rather than treat these as demonstrating the absence of the constituent that is being tested, or at least as no evidence of presence or absence, he takes these non-detects to prove the *presence* of the tested-for constituent, but just at levels below the analytical method's detection limit. He therefore replaces "non-detect" with the midpoint value between zero and the relevant detection limit. *See*

id. at 26.. This again has two distorting effects. First, as with the substitution for missing variables, it creates data where none were measured. Second, the fact that Dr. Olsen used different detection limits for the same constituents further distorts the analysis. *Id.* at 26, 32-33. While small in absolute numbers (*e.g.*, 0.01 vs. 0.001), these differences are magnified by Dr. Olsen's use of logarithmic values in his PCA runs. When converted to a log scale, 0.01 becomes -2, 0.001 becomes -3, and so forth, which can have a substantial effect on the outcomes. *Id.* at 32. Yet, Dr. Olsen neither acknowledges this effect, nor conducts any tests to determine whether they alter the outcomes. *Id.* at 33.

4. Merging Incompatible Datasets

In addition to the data that Plaintiffs gathered, Dr. Olsen also included in his PCA runs data gathered by USGS. But Dr. Olsen merged these in his data sets without any analysis as to whether the data sets were compatible. *Id.* at 19-20. Had he undertaken this analysis, he would have learned that when run separately, Plaintiffs' data and the USGS data produce substantially different PCA results, with different constituents showing significant effects on different principal components. *Id.* at 26-27. Again, this does not explain *why* the data sets are different,[14] but it does show that they are not compatible and should not have been merged.

5. Unexplained Data Substitution and Incomplete Data Sets

Finally, Dr. Olsen's data flaws are compounded by the manner in which his PCA run datasets were compiled, as the data that he represents was included in his actual runs do not consistently track back to the master Access database. Dr. Olsen's SW3 run included 573 samples tested for 26 constituents, which results in 14,898 independent data points (26 x 573).

[14] Such differences could be caused by the use of inconsistent analytical methods by different labs as was the case with Plaintiffs' data, *see* Ex. 7 at 9, or by inconsistent data collection methods, as Dr. Olsen acknowledged was an issue, Ex. 2 at 6-36; Ex. 3 at 19.

Id. at 36. Dr. Olsen acknowledged having to create data to fill 915 of these points. However, when Dr. Cowan and his team attempted to recreate this database, they discovered a substantial error rate. *Id.* at 35-38. Of the 915 variables that Dr. Olsen represented as being missing, Dr. Cowan found that 66 did in fact have data in the Access database, but had been nevertheless been replaced with a new value. Moreover, Dr. Cowan discovered a further 499 values that were missing in the Access database, yet which appear in SW3 with data but without explanation. And, he found an additional 551 data points that have a different value in SW3 than in the Access database. *Id.* at 38. Ultimately, 13 percent of the data in SW3 was either substituted or some manner altered from what was actually measured in the IRW.

In fact, Dr. Olsen did not follow his own stated criteria for selecting data. Dr. Olsen set out to "[i]nclude as many parameters as possible" in order to "allow more definitive and accurate distinction of sources of contamination, to better explain differences in waste compositions, and to better explain relationships of waste composition." Ex. 2 at 6-42 – 6-43. Yet, while his main SW3 run included only 267 samples with a full compliment of real-world test results, it is possible to construct a much larger data set without any missing values. Dr. Cowan constructed a dataset comprising 419 samples tested for 56 constituents without any missing data at all. Ex. 3 at 46-51. And even when required bacteria data is forced back into the dataset, it is still possible to construct a dataset of 296 samples across 60 variables, substantially larger than Dr. Olsen's most "important" run. Ex. 2 at 6-50; Ex. 3 at 48. When the larger dataset is run through Dr. Olsen's PCA, it generates substantially different results, with constituents loading into different PCs than in Dr. Olsen's analysis. Ex. 3 at 49-50. This demonstrates that constituents other than those that Dr. Olsen decided to include in SW3 are important to explain the overall variability, and when tested in light of the most complete dataset possible, his "poultry signature"

disappears. *Id.* at 50-51.

Individually, any of the foregoing (with the exception of the unexplained substitution of new data) might be an appropriate and justifiable approach to data in a particular case, depending on the circumstances, the amount of data in question, and the analyses run to confirm the lack of injected bias. But here, when combined and without substantial analysis to confirm a lack of bias, Dr. Olsen's data compilation and substitution methods combine to create a data set that is deeply flawed and in substantial part non-reproducible, which renders is unreliable and inappropriate to support expert testimony in federal court.

CONCLUSION

For the foregoing reasons, Dr. Olsen's PCA analysis should be excluded.

Respectfully submitted,

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I also hereby certify that I served the attached documents by United States Postal Service, proper postage paid, on the following who are not registered participants of the ECF System:

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